

THE
REPERTORY
OF
PATENT INVENTIONS.

No. LXIII. NEW SERIES.—MARCH, 1839.

Specification of the Patent granted to WILLIAM FOTHERGILL COOKE, of Breed's Place, Hastings, in the County of Sussex, Esquire, for Improvements in Giving Signals and Sounding Alarums at distant Places, by means of Electric Currents transmitted through Metallic Circuits.—Sealed April 18, 1838.

WITH AN ENGRAVING.

To all to whom these presents shall come, &c. &c.—
Now know ye, that in compliance with the said proviso, I, the said William Fothergill Cooke, do hereby declare that my said invention is described and ascertained in manner following, and by the aid of the two sheets of drawings hereunto annexed (that is to say):—

My said improvements relate to certain apparatus or mechanism and modes of giving signals and sounding alarums at distant places by means of electric currents transmitted through metallic circuits, for which a former patent was granted to me, the said William Fothergill Cooke, and to Charles Wheatstone, by his late Majesty King William IV., bearing date at Westminster June 12, 1837, and whereof the specification stands enrolled in the No. LXIII.—VOL. XI. s

chapel of the Rolls. And in that said former specification it is fully explained how the transmission of an electric current or currents through certain metallic conducting wires, or telegraphic wires, (which are formed or conjoined, for the time being, into circuits suitably for such transmission), may be caused to communicate determinate angular motions to certain magnetic needles, which are suitably disposed and combined for pointing out, upon suitably marked dials or tablets, the significations of the signals which are intended to be given by any such determinate angular motions aforesaid, as may, from time to time, be communicated by transmission of an electric current or currents, as aforesaid, to one or more such needles at a time. And it is also fully explained how the transmission of an electric current or currents, as aforesaid, may be caused to sound alarums by medium of the attractive force of occasional or temporary voltaic magnetism, which will be excited in masses of soft iron by such transmission. And duplicates of the apparatus containing such magnetic needles, with their dial aforesaid, and with such alarums as aforesaid, together with suitable voltaic batteries, and certain buttons or finger keys, as therein fully described, being situated at the distant places between which communications are to be made by giving signals and sounding alarums, a set or series of the metallic conducting wires or telegraphic wires aforesaid is extended from one of those distant places to the other, each wire preserving its own course of metallic continuity, independently of, or insulated from, all the other wires; and one such wire is carried as a part of the said course in suitable proximity to each of the magnetic needles of each duplicate set of such needles, and one such wire is carried as part of its said course in suitable proximity to each of the aforesaid masses of soft iron; all which is fully explained in the said specification; and it is also therein explained how the ends or extremities of any two or more such conducting wires can, by pressure of the hands or

fingers upon suitable buttons or finger keys, be connected to the two opposite poles of the voltaic battery belonging to such finger keys, whilst the contrary ends of the wires to those ends thereof which are so connected are at the same time conjoined together, whereby the said wires so connected become formed into a metallic circuit or circuits suitably for the transmission of an electric current or currents throughout the length of two conjoined wires; and such transmission is (as already stated) made the means of giving signals by the angular motions that such current or currents will communicate to the magnetic needles, which, in consequence of their proximity to the wire or wires through which that transmission is made, are subjected to the influence of such current or currents, or is made the means of sounding alarums by the action of occasional or temporary voltaic magnetism excited in the aforesaid masses of soft iron, which, in consequence of their proximity to the wire or wires through which that transmission is made, are subjected to the influence of such current or currents; and whatever signals are so given, or alarums are so sounded by the apparatus at one of the distant places, like signals or alarums will be at the same time given or sounded by the duplicate of the said apparatus at the other of such distant places. And it is also fully explained that such transmission of an electric current or currents may be made to proceed either in one direction through each such metallic circuit or circuits as may be formed by connecting any two or more of the conducting wires aforesaid with the two opposite poles of the battery, or else may be made to proceed in a contrary direction through the same circuit or circuits, and thereby the angular motions which will, in consequence, be given to the magnetic needles will take place either in one direction or else in a contrary direction, so as to enable the apparatus to give two different significations or signals by the pointing of each needle in each of the aforesaid duplicate apparatuses at distant places. And also it is fully

explained how several magnetic needles may be combined together, in order to point out the significations of signals on a suitably marked dial by the concurrent angular motion of two or more of such needles; and how a great diversity of such signals can be given by the several variations of such concurrent pointing of two or more needles, which can be obtained by varying the combinations, or coupling together, of the several conducting wires, when, by pressure on the buttons or finger-keys aforesaid, the ends of any two or more of the wires are connected with the two opposite poles of the battery, to form those two or more wires into a metallic circuit or circuits for the transmission of an electric current or currents; and the number and diversity of such variations can be augmented by reversing the direction of such transmission as aforesaid. And it is also explained how signals may be given, or alarums sounded, by a person stationed at either of the aforesaid distant places, by merely applying his hands or fingers to press the buttons or finger-keys belonging to that part of the apparatus which is in his presence; and the duplicate part of the apparatus which is situated at the other distant place, will at the same time give like signals, and sound like alarums, which may be observed and recorded by the person stationed at that other last mentioned distant place; and then that person may, in an instant afterwards, become the operator to give signals or sound alarums, which being given or sounded in the same manner, and at the same time, by both the distant parts of the apparatus, may be observed and recorded by the first-mentioned person; so that a mutual interchange of signals and alarums, constituting a telegraphic communication, can be carried on between persons stationed at the distant places where the duplicate parts of the apparatus are situated. And it is also explained how other duplicates of the apparatuses containing magnetic needles with their dials, though without any voltaic batteries or finger-keys, and containing alarums,

may be disposed at intermediate places between the two most distant places hereinbefore mentioned, and which for distinction are called the two termini; and how, by suitable connexions of the conducting or telegraphic wires, which extend through such intermediate places as part of their course of extension between those termini, the same signals will be given, or the same alarums will be sounded, at all such intermediate places, as are at the same time given or sounded at the two termini.

And respecting my present improvements, which are the subject of the said letters patent of the 18th of April last, I will first describe certain apparatus, or mechanism, which is constructed according to my said present improvements, and then, at the conclusion of this my specification, I will point out the particular improvements whereof the exclusive use is granted by the said letters patent.

Description of the Drawing.

And whereas, by the means explained as aforesaid, in the said former specification, a mutual telegraphic conversation or correspondence can be carried on, or interchanged between two persons, situated at the two extreme ends or termini of a long line of conducting or telegraphic-wires, so that either of those persons, by giving signals, and sounding alarums, in a suitable manner, as therein described, can communicate intelligence to, or receive intelligence from, his correspondent; and whereas, by the means therein explained as aforesaid, duplicates of the apparatus, (figs. A to G, sheet I, of the drawings thereunto annexed) containing needles, and of the apparatus (sheet, II) for sounding alarums, may also be situated at intermediate places between the two termini, in which case the same signals will be exhibited by the needles of all the several duplicate apparatuses or dials, at intermediate places, and the same alarums will be sounded at those places, as are exhibited, or sounded by the apparatuses

at the two termini; hence, it is evident, that, although persons situated at such intermediate places may acquire a knowledge of all the telegraphic communications, which are passing and repassing between the two correspondents at the two termini; nevertheless those said persons at intermediate places, would not have any power of giving signals, or sounding alarums; and this being understood, I shall now proceed, as part of my present specification, to explain how any duplicate apparatus, at such intermediate places, may be provided with a set of buttons, or finger-keys, and their accessories, and with a voltaic battery, together with adequate means of instantaneously connecting and disconnecting the said keys and battery, with the long conducting or telegraphic-wires, so as to enable persons at any of such intermediate places, to give signals, and sound alarums, at either one or other of the termini, whichever may be chosen by such persons, as well as at such other of the said intermediate places, as may be situated between that terminus, which is so chosen, and the aforesaid intermediate place from which the signals are to be given, or alarums to be sounded: wherefore, by the means now about to be described, the duplicate apparatus, situated at any intermediate place between the two termini, may, at pleasure, be in an instant endowed with all the qualifications of the apparatus at one of the termini; that is, all the qualifications requisite for the purpose of giving signals and sounding alarums, from such intermediate places, in the manner described in the former specification, in reference to the apparatuses at the two termini; but, nevertheless, in an instant, the means of mutual communication between the two termini can be perfectly restored, without any longer interruption to that communication, than during the time of making a communication from the intermediate place.

The figures at the lower part of sheet A, of the drawings hereunto annexed, which figures are marked fig. A, and fig. b, may represent the apparatuses at the two ter-

mini; whilst fig. τ , represents an apparatus at an intermediate place between the two termini. Each of the dials in those three figures is represented with four needles, whereof each needle is adapted to give two significations, by its own individual motions, as well as other signals, by its pointing, concurrently and contemporaneously, with another needle, or with other needles, as is explained in the former specification, respecting fig. z , sheet III, thereof. And note, the arrangement of the needles and characters on the dials (figs. A , b , and τ , sheet A, hereof), are the same in effect as in that figure, z , of the former specification, although somewhat different in appearance. The long conducting or telegraphic-wires, 21, 22, 23, 24, and 25, sheet A, which should be, at least, five in number, may form a continuity of metal, extending from fig. A , to fig. b , and passing through the intermediate apparatus, fig. τ , and the four first mentioned of those wires making their appropriate coils around the four needles of the apparatus fig. τ , in the same manner as is described in the former specification, in respect to all five wires in figs. A , and b , sheet I, thereof; and in such case, whatever signal is exhibited by the needles of the dials, (figs. A , and b , sheet A) or alarum sounded, at the two termini, the same will be exhibited by the dial figure τ , or sounded by its alarum, as already herein-before stated; but, according to the arrangement now to be described, the said long telegraphic-wires admit of having their continuity of metal disconnected at the intermediate apparatus, fig. τ , so as to divide the whole length or extension of those wires into two portions, whereof one portion is to be used and the other is to be disused, in such manner as to leave that apparatus τ , for the time, with no other connexion by means of the said wires, excepting with the apparatus fig. A . at one terminus, through one of the said portions, or otherwise with the apparatus fig. b , at the other terminus, through the other of the said portions, according as it

may be intended to give signals or sound alarums from the said intermediate apparatus fig. *τ*, either to the terminal apparatus fig. *A*, or otherwise to the terminal apparatus fig. *b*: and the same action whereby the long telegraphic-wires are so disconnected and divided into two portions, also connects a set of buttons and finger-keys belonging to fig. *τ*, and a voltaic battery, with that portion of the said wires which is to be retained in use, in such manner that the intermediate apparatus, *τ*, becomes fully qualified for carrying on a mutual telegraphic-communication, in the manner hereinbefore stated, with that terminal apparatus, (either fig. *A*, or else fig. *b*,) with which it is for the time put into connexion. The requisite connexion and disconnexion can be very readily made by merely moving an index, *g*, fig. *τ*, which projects out through an upright slit in one margin of the frame of the box or case in which the apparatus, fig. *τ*, is contained. When the index, *g*, is raised up in its slit, so as to come opposite to the mark, *b*, it causes the terminal apparatus, fig. *A*, to be wholly disconnected from the apparatus, fig. *τ*; but at the same time the said raising up of the index, *g*, establishes the requisite connexion between the apparatus, fig. *τ*, together with its own finger-keys and voltaic battery, and the other terminal apparatus, fig. *b*, suitably for carrying on a mutual telegraphic communication between fig. *τ* and fig. *b*; but nevertheless, the said raising up of the index, *g*, does not disconnect the alarum apparatus which belongs to the intermediate apparatus, fig. *τ*, from its connexion with the terminal apparatus fig. *A*. Or, if the index, *g*, is put down in its slit, so as to come opposite to the mark, *A*, fig. *τ*, then it causes a total disconnexion between the apparatus, fig. *τ*, and the terminal apparatus, fig. *b*, excepting as relates to the alarum at the intermediate apparatus, fig. *τ*; but, at the same time, the said putting down of the index, *g*, establishes the requisite communication between the apparatus, fig. *τ*, together with its own finger-keys and voltaic battery, and the other

terminal apparatus, fig. A, suitably for carrying on a mutual telegraphic communication between fig. T. and fig. A. But if the said index, *g*, is placed in its intermediate position, as represented in fig. T, then each of the several five long telegraphic-wires becomes reconnected into one continuity of metal extending from fig. A. to fig. B.; the coils of wires around the four several needles of the intermediate apparatus, fig. T, as well as the coils for its alarm, being included in the said continuity of metal formed by four out of the five telegraphic-wires, as part of the extension of those four, but the finger-keys and the voltaic battery of the apparatus, fig. T, being wholly disconnected from the telegraphic wires; in which state the intermediate apparatus, T, answers, in all its conditions, to the description given in the former specification, of a duplicate apparatus, containing needles, and provided with an alarm, which may be situated at an intermediate place between the two termini.

The index, *g*, sheet A, is one end of a wooden lever, which is contained within the box or case of the apparatus, fig. T, disposed in a direction across the same from front to back, and is marked, *f*, in figs. P, *p*, *m*, *l*, *la*, and *k*, wherein it is drawn full size; it is mounted on a horizontal axis, *o*. I call it the current-director. Its end nearest to the index, *g*, is included between two slender springs, *h*, *h*, which are adapted to retain it in either of its three intended positions above described; that is, either with the index, *g*, raised up, or else put down, or else in its intermediate position. The springs, *h*, *h*, yield by opening one from the other, when the index, *g*, is raised up or put down, but collapse together again around it, when the index reaches either of its three intended resting places.

The five finger-keys, 31, 32, 33, 34, and 35, fig. Pa, which are very similar to those described in the former specification, (in reference to figs. H, I, J, sheet I, thereof) are disposed with their length horizontal, and across the

box or case, below the dial, their ends coming forwards in front thereof, so that the ten buttons belonging to those five keys stand up in two rows through the cover of the lower and advanced part of the box; all this is sufficiently evident from the front-elevation, fig. *r*, or fig. *t*, which is the same, but which has also a vertical section of the box or case, fig. *u*, drawn side by side with it, and also a horizontal plan, fig. *x*, drawn beneath fig. *u*. Each key has a connecting-wire proceeding from it, as shewn at 91, 92, 93, 94, and 95. fig. *Pa*, to connect it with a small piece of metal, which is affixed to the wooden current-director, *f*, in the manner shewn, by the like numbers, in figs. *P*, *p*, *l*, and *la*; all the said five pieces of metal being fixed, side by side, on the wood, *f*, and so far apart thereon as to be insulated one from another; and the several wires, 91, 92, 93, 94, and 95, are also insulated one from another.

All connexion of the finger-keys with the telegraphic-wires, is, by this means, rendered dependent upon the current-director, *f*, which, being placed in its intermediate position already mentioned, in reference to fig. *r*, (and in which it is shewn in fig. *p*.) then allows of no connexion between the telegraphic-wires and the finger-keys, but leaves the latter wholly disconnected and useless for the present; also the two fixed pole-bars, 26, and 36, fig. *Pa*, which extend across under the finger-keys, and beneath the two rows of buttons thereon, in the manner described in the former specification, (in reference to figs. *n*, and *h*, sheet 1, thereof) are not connected directly by wires, with the two poles of the voltaic-battery, as described in the former specification; but two insulated connecting-wires, 87, and 97, fig. *Pa*, sheet A, proceed from those pole-bars, 26, and 36, to connect them with two distinct and insulated pieces of metal, which are fixed side by side, on the tail, or short end of the current-director, *f*, as is shewn at 87, and 97, in figs. *P*, and *p*; by which means all connexion of the voltaic-battery with the

pole-bars, and through them with the finger-keys, is rendered dependent upon the current-director, *f*, which being placed in its intermediate position, as in fig. *p*, leaves the pole-bars, 26, and 36, wholly disconnected from the voltaic-battery, which is therefore useless for the present.

The five long telegraphic-wires, 21, 22, 23, 24, and 25, preserve their continuity of metal, in their passage through the intermediate apparatus, fig. *r*, so long as the current-director, *f*, thereof, is in its intermediate position, as in fig. *p*; for instance, those portions of the five telegraphic-wires, which extend from the terminal apparatus, fig. *A*, enter into the intermediate apparatus, fig. *r*, by being attached to five insulated buttons, at one side thereof; one of those wires and buttons is more particularly shewn at 22*m*, fig. *la*. The said button is suitably connected with a brass spring, which enters into the box, as at 22*a*, and bears by its elasticity against another like spring, 22*b*, so as to preserve the requisite continuity of metal between those two springs; and from the spring, 22*b*, the continuation, 22*c*, of the said telegraphic-wire proceeds to make its coils, 8, 8, around the second magnetic needle of the intermediate apparatus, fig. *r*, in the manner fully described in the former specification (respecting figs. *c* to *G*. sheet 1, thereof); and after having made those coils, the further continuation, 22*d*, of the said telegraphic-wire, proceeds to a spring, 22*e*, which bears by its elasticity against another like spring, 22*f*, so as to preserve the requisite continuity of metal between those two springs, and then, by means of a button, 22*g*, suitably connected with the spring, 22*f*, the same is united to that portion of the long telegraphic-wire, 22, which extends to the other terminal apparatus, fig. *b*. Four of the five telegraphic-wires make a like course of metallic continuity through the intermediate apparatus, fig. *r*, and the fifth wire, 25, a nearly similar course, but it makes no coils around a magnetic-needle (see the dotted lines, 25*dc*, fig. *la*, sheet *A*); that is, each wire

proceeds by the intervention of four such springs, as 22*a*, 22*b*, and 22*e*, 22*f*, with two places of contact, formed between four of those springs, for preserving the requisite metallic continuity of each telegraphic-wire; but all the said several springs for the different wires are disposed, side by side, in rows, and are insulated one from another, by being fixed to a suitable part of the wood of the frame, as shewn in fig. *p*, by 21*b*, 22*b*, 23*b*, 24*b*, 25*b*, also 21*e*, 22*e*, 23*e*, 24*e*, 25*e*.

Note, respecting that one of the five telegraphic wires to which an alarum apparatus, described in the former specification, (in reference to fig. *s*, sheet II, thereof) is connected, and the metallic continuity of which wire is to form coils around the magnetic needle of that alarum apparatus, (as is represented in that fig. *s*, sheet II), and which may be the wire 21, sheet A, whereof the course of metallic continuity is nearly similar to what has been hereinbefore traced through the intermediate apparatus, fig. *r*; now the course of the said wire, 21, being, as hereinbefore described, respecting the wire, 22, as far as the spring, 21*f*, fig. *l*, that spring is not connected immediately with the button, 21*g*, as is the case with the corresponding spring and button for each of the other four telegraphic wires, but the spring 21*f*, forms a contact, as is shewn in fig. *l*, with a piece of metal which is affixed to the inside of a wooden prominence, *e*, fig. *l*, of the index, *g*; and from that piece of metal a connecting wire, 21*h*, proceeds to the button, 75, which belongs to the alarum apparatus described in the former specification, and therein shewn in fig. *s*, sheet II; that button, 75, being at the commencement of the coiling which the wire is to make around the magnetic needle of the alarum apparatus. Also the button, 76, which is at the termination of the same coiling, is connected by the wire, 21*k*, fig. *l*, sheet A, with another piece of metal, which is affixed to the outside of the aforesaid wooden prominence, *e*, of the index, *g*, that is at the contrary side thereof to

the before-mentioned piece of metal to which the wire, 21*h*, is connected, in order that the said two pieces of metal may be insulated one from the other by the wood, *e*, intervening between them. Against the said outside piece of metal, a spring, 21*l*, bears laterally with close contact, and to that spring the button, 21*g*, is affixed for connecting the long telegraphic-wire, 21, which extends to the terminal apparatus, fig. *b*. The consequence of this arrangement of the wire, 21, is, that whenever that wire is formed into a metallic circuit, so that an electric current is transmitted through it in a suitable direction for causing the alarums belonging to the terminal apparatuses, fig. *a*, and fig. *b*, to be sounded, the alarum belonging to the intermediate apparatus, fig. *r*, will likewise be sounded in the same manner as has been hereinbefore stated, and as is fully described in the former specification. But whenever it is required to prevent the last-mentioned alarum from being sounded by the aforesaid transmission of an electric current in the suitable direction through the wire, 21, then the alarum-wires, 21*h*, 75, 76, 21*k*, fig. *l*, of the intermediate apparatus, *r*, can be disconnected by turning a small thumb-screw, which is tapped through the spring, 21*l*, fig. *l*, until the point thereof reaches the spring, 21*f*, in order to make such a metallic contact between the two springs, 21*l*, and 21*f*, that the electric current will pass direct from one to the other, without being transmitted through the wires, 21*h*, 21*k*, of the alarum, and consequently without causing the said alarum to be sounded. If the screw, 21*l*, is screwed somewhat further than merely to make the said contact, it will bear off the spring, 21*l*, from its contact with the piece of metal at the outside of the prominence, *e*, and render the aforesaid disconnection quite effectual. Note, this mode of disconnecting the alarum of the intermediate apparatus, fig. *r*, effects that purpose in nearly the same manner as that described in the former specification, whereby the spring-pieces, 72, and sliding bolts

73, figs. *h* and *h*, sheet 1 thereof, operate to disconnect the alarums of the terminal apparatuses, fig. *A*, and fig. *b*, of that sheet 1, when required.

All the circumstances above explained respecting the intermediate apparatus, fig. *r*, being kept in mind, the operation of the current director, *f*, with its accessories, may now be explained, whereby that apparatus, *r*, is rendered capable of giving signals and sounding alarums at either one or other of the termini, whichever of them may for the time be chosen. For instance, if the index, *g*, fig. *r*, is put down opposite to the mark, *A*, then, as before mentioned, the intermediate apparatus, fig. *r*, will be prepared for mutual telegraphic communication with the terminal apparatus fig. *A*. For the index, *g*, at the front end of the current-director, *f*, figs. *m* and *p*, being put down, tilts the current-director, *f*, into an inclined position, whereby the pieces of metal, 91, 92, 93, 94, and 95, at one side of it, are brought down into lateral contact with the springs, 21*e*, 22*e*, 23*e*, 24*e*, and 25*e*, which are beneath it, (see also fig. *l*,) so as to bring the latter springs into connexion, through the wires, 91, 92, 93, 94, and 95, figs. *p* and *pa*, with the finger-keys, 31, 32, 33, 34, and 35; and also by the same lateral contact aforesaid, the said springs, 21*e*, 22*e*, 23*e*, 24*e*, and 25*e*, are bended aside and disconnected from their previous contact with their adjacent springs, 21*f*, 22*f*, 23*f*, 24*f*, and 25*f*. The consequence of the disconnexion is, that the metallic continuity of all the five telegraphic wires is cut off at the intermediate apparatus, fig. *r*, so as to disconnect those portions thereof which extend therefrom to the terminal apparatus fig. *b*; and also the five finger-keys of the intermediate apparatus, fig. *r*, are become connected to the several ends of those portions of the five telegraphic-wires, which extend to the terminal apparatus *A*, and which portions are now to be used for carrying on a mutual telegraphic correspondence between the two apparatuses, *A*, and *r*, by forming those portions

into metallic circuits, exactly in the same manner as is fully explained in the former specification, respecting the two terminal apparatuses, fig. *A*, and fig. *b*, sheet 1, thereof, and therefore it is unnecessary to enter into a repetition of the description. But note, the aforesaid tilting down of the current-director, *f*, fig. *p*, sheet *A*, by elevating its tail, or short end, raises up the pieces of metal, 87, and 97, which, as beforementioned, are connected by wires, 87, and 97, with the pole-bars, 26, and 36, fig. *Pa*, of the set of keys of the intermediate apparatus, *T*, so as to bring those pieces of metal, 87, and 97, into lateral contact with springs, 27*a*, and 37*a*, which are situated over the tail end of the current-director, *f*, (see also fig. *k*) and which springs are connected by branches of the two wires, 27, and 37, with the two poles of the voltaic battery belonging to the intermediate apparatus, fig. *T*, and which battery is thus brought into connection therewith, ready for operation whenever it is required to give signals or sound alarums at the terminal apparatus fig. *A*, as well as at any other duplicate apparatus containing needles which may be situated at any intermediate place between fig. *T* and fig. *A*.

And note, respecting the alarum belonging to the intermediate apparatus, fig. *T*, the same is not connected with those portions of the telegraphic-wires which extend to the terminal apparatus fig. *A*, when the current-director is tilted down, as herein-before mentioned, but on the contrary, the said alarum apparatus becomes connected with those portions of the telegraphic-wires, which extend to the other terminal apparatus, fig. *b*. To effect this, a piece of metal plate, which is fixed to the side of the current-director, *f*, as shewn at 17, fig. *m*, (and which I call the cross-plate,) comes down into lateral contact with all the five springs, 21*f*, 22*f*, 23*f*, 24*f*, and 25*f*, fig. *l*, in such manner as to connect all those springs together by a lateral connexion, resulting from the same action, whereby they have been disconnected from their previous contact

with their fellow-springs, 21*e*, 22*e*, 23*e*, 24*e*, and 25*e*, as before mentioned ; but note, the wood of the current-director, *f*, insulates the cross-plate, 17, at one side of it, from the detached pieces of metal, 91, 92, 93, 94, and 95, at the other side of it. Also, the aforesaid tilting down of the current-director, *f*, depressing its prominence, *e*, fig. *l*, retains the piece of metal at the outside thereof, belonging to the alarum-wire, 21*k*, in its previous lateral contact with the spring, 21*l*, so as to continue to bend the same away from all contact with the spring, 21*f* ; but the latter still continues in contact with the piece of metal, at the inside of the prominence, *e*, which belongs to the alarum-wire, 21*h*. The consequence of this situation of the parts is, that the alarum of the intermediate apparatus, *r*, continues to be connected with those portions of the telegraphic-wires which extend from the intermediate apparatus, fig. *r*, to the terminal apparatus, fig. *b* ; wherefore, if an electric current is transmitted from one pole of the voltaic battery belonging to the terminal apparatus, fig. *b*, through the telegraphic-wire, 21, which extends from the terminal apparatus, fig. *b*, to the button, 21*g*, and spring, 21*l*, fig. *l* ; the latter being separated from its fellow-spring, 21*f*, but being in contact with the outside piece of metal on the prominence, *e*, the said current will be transmitted through the wire, 21*k*, to the button, 76, and thence through the wire-coils around the magnetic needle of the alarum-apparatus described in the former specification, (in reference to fig. *s*, sheet II, thereof,) causing that apparatus to sound its alarum ; and then the current will proceed to the button, 75, sheet A, and through the wire, 21*h*, to the piece of metal at the inside of the prominence, *e*, and thence to one end of the spring, 21*f*, which is in contact therewith, and from the other end of that spring, by the cross-plate, 17, the said current will be transmitted to any other of the springs, 22*f*, 23*f*, 24*f*, or 25*f*, whereof the corresponding telegraphic-wire extending to the terminal ap-

paratus fig. *b*, may be for the time in connexion with the contrary pole of the voltaic battery to that pole thereof which has been recently mentioned.

Or, if the index, *g*, fig. *r*, is raised up opposite to the mark, *b*, then, as before mentioned, the intermediate apparatus, fig. *r*, will be prepared for mutual telegraphic communication with the terminal apparatus, fig. *b*; for the current director, *f*, fig. *p*, being tilted up into an inclined position, its pieces of metal, 91, 92, 93, 94, and 95, are raised up into lateral contact with the five springs, 21*b*, 22*b*, 23*b*, 24*b*, and 25*b*, which are above it, so as to bring the latter springs into connexion, through the wires, 91, 92, 93, 94, and 95, figs. *p*, and *pa*, with the finger-keys, 31, 32, 33, 34, and 35; also by the same lateral contact aforesaid, the said springs, 21*b*, 22*b*, 23*b*, 24*b*, and 25*b*, are bended aside and disconnected from their previous contact with their adjacent springs, 21*a*, 22*a*, 23*a*, 24*a*, and 25*a*. The consequence of the disconnexion is, that the metallic continuity of all the five telegraphic-wires is cut off at the intermediate apparatus, fig. *r*, so as to disconnect those portions thereof which extend therefrom to the terminal apparatus fig. *a*; and also the five finger-keys of the intermediate apparatus, fig. *r*, are become connected to the several ends of those portions of the five telegraphic-wires which extend to the terminal apparatus, fig. *b*, and which portions are now to be used for carrying on a mutual telegraphic correspondence between the two apparatuses, *b*, and *r*, by forming those said portions into metallic circuits, exactly in the same manner as is fully explained in the former specification respecting the two terminal apparatuses, fig. *a* and fig. *b*, sheet 1 thereof, and therefore it is unnecessary to enter into a repetition of the description. But note, the aforesaid tilting up of the current director, *f*, fig. *p*, by depressing its tail or short end, depresses the pieces of metal, 87 and 97, which, as before mentioned, are connected by wires, 87 and 97, with the pole-bars, 26 and

36, fig. *pa*, of the set of keys of the intermediate apparatus, *r*, so as to bring those pieces of metal, 87 and 97, into lateral contact with springs, 37 and 27, which are situated beneath the tail end of the current director, *f*, (see also fig. *k*); and which springs are connected by branches of the two wires, 27 and 37, with the two poles of the voltaic battery belonging to the intermediate apparatus, fig. *r*; and which battery is thus brought into connexion therewith, ready for sending forth electric currents in a suitable direction, whenever it is required to give signals or sound alarms at the terminal apparatus fig. *b*, as well as at any other duplicate apparatus containing needles which may be situated at any intermediate place between fig. *r*, and fig. *b*.

And note, the alarm belonging to the intermediate apparatus, fig. *r*, is not now connected with those portions of the telegraphic-wires which extend to the terminal apparatus, fig. *b*, but, on the contrary, the said alarm apparatus becomes connected with those portions of the telegraphic-wires which extend to the other terminal apparatus, fig. *a*. This results from the cross-plate, 17, rising up into lateral contact with all the five springs, 21*a*, 22*a*, 23*a*, 24*a*, and 25*a*, fig. *l*, in such manner as to connect all those springs together by a lateral connexion resulting from the same action whereby they have been disconnected from their previous contact with their fellow-springs, 21*b*, 22*b*, 23*b*, 24*b*, and 25*b*, as hereinbefore stated. Also the aforesaid tilting up of the current-director, *f*, by elevating its prominence, *e*, fig. *l*, raises the piece of metal at the outside thereof belonging to the alarm-wire, 21*k*, into lateral contact with the spring, 21*m*, so as to bend the same away from its previous contact with its fellow-spring, 21*a*; but as the latter is now brought into contact with the piece of metal at the inside of the prominence, *e*, which belongs to the alarm-wire, 21*k*, the alarm of the intermediate apparatus, *r*, becomes connected with those portions of the

telegraphic-wires which extend from the intermediate apparatus, fig. *r*, to the terminal apparatus fig. *A* ; wherefore, if an electric current is transmitted from one pole of the voltaic battery belonging to the terminal apparatus, fig. *A*, through that telegraphic-wire, *2l*, which extends from the said terminal apparatus, fig. *A*, to the button and spring, *2lm*, fig. *l*, the latter being in contact with the piece of metal on the outside of the prominence, *e*, will transmit the said current through the wire, *2lk*, to the button, *76*, and thence through the wire-coils around the magnetic needle of the alarum apparatus, causing the same to sound its alarum, and then to the button, *75*, and through the wire, *2lh*, to the piece of metal at the inside of the prominence, *e*, and thence to the spring, *2la*, which is in contact therewith, and from that by the cross-plate, *17*, the said current will be transmitted to any other of the springs, *22a*, *23a*, *24a*, or *25a*, whereof the corresponding telegraphic-wire extending to the terminal apparatus, fig. *A*, may be for the time in connection with the contrary pole of the voltaic battery to that pole thereof which has been recently mentioned.

And note, it cannot be necessary to have the alarum of the intermediate apparatus, fig. *r*, capable of being sounded by transmission from that terminus, fig. *A*, or fig. *b*, with which a mutual telegraphic communication is carrying on, during the time of such communication, provided the person at the intermediate apparatus, *r*, never keeps the index, *g*, thereof, up or down any longer than he requires it to be so for enabling him to make his communication ; for as soon as ever he has finished the same, he should restore the index, *g*, to its intermediate position, in order to give the means of mutual communication between one terminal apparatus, fig. *A*, and the other, fig. *b*, in which case the alarum of the intermediate apparatus, *r*, would be capable of being sounded by transmission from either terminus, provided that the thumb-screw of the spring *2ll*, fig. *l*, is serewed out, as there

shewn, and as has been hereinbefore stated. But on the other hand, it is a great advantage to be able to sound the alarum of the intermediate apparatus by transmission from that terminal apparatus with which the mutual telegraphic communication is not going on for the time, because it enables the person at the last-mentioned terminus to call the attention of the person at the intermediate apparatus whenever any communication is required to be made to him, or to the other terminus beyond him, and the sounding of such alarum gives him notice that he must prepare his intermediate apparatus, fig. *r*, for mutual telegraphic communication between the termini, by putting its index, *g*, to its middle position. And note, owing to the cross-plate, 17, fig. *m*, on the current director, *f*, putting all the five springs, 21*a*, to 21*f*, into a transverse or lateral connexion one with another; whenever the intermediate apparatus, fig. *r*, is disconnected from one terminal apparatus, by raising up or putting down its index, *g*, as before explained, in order that it may be enabled to carry on a mutual telegraphic communication with the other terminal apparatus, as aforesaid, which is not disconnected, that terminal apparatus which is so disconnected from the intermediate apparatus, so as to be incapacitated for the present for giving signals thereat, will nevertheless preserve the power of sounding the alarum at the intermediate apparatus, as already described; and also the said terminal apparatus which is so disconnected, will still preserve the power of giving signals or sounding alarums at any other duplicate apparatus or apparatuses, which may be situated at intervening places between the said terminal apparatus and the aforesaid intermediate apparatus which is disconnected from that terminal apparatus. Note, the use of the current director, *f*, and of putting its index, *g*, up or down, as above described, is to cause the several electric currents which may be transmitted along the several coils of wire, 8, around the magnetic needles of the intermediate appa-

ratus, fig. T, to assume, in each case, the proper direction for influencing those needles, in the same manner as the needles of the terminal apparatus, which is at the time connected with the intermediate apparatus, are influenced by the same electric currents.

(*To be continued.*)

Specification of the Patent granted to RICHARD BRADLEY, WILLIAM BARROWS, and JOSEPH HALL, of Bloomfield Iron Works, in the Parish of Tipton, in the County of Stafford, Iron Masters, and Co-Partners, for an Improved Method or Means of Making Iron.—Sealed August 21, 1838.

WITH AN ENGRAVING.

To all to whom these presents shall come, &c., &c.—
Now know ye, that in compliance with the said proviso, we, the said Richard Bradley, William Barrows, and Joseph Hall, do hereby declare the nature of our said invention, and the manner in which the same is to be performed, are fully described and ascertained, in and by the following statement thereof, reference being had to the drawing hereunto annexed, and to the figures and letters marked thereon (that is to say):—

According to the ordinary mode or means of making malleable or wrought-iron, the ore is first smelted by means of blast-furnaces, and the products therefrom are called pigs, which are next submitted to the process of refining, and then to the operation called puddling. In some cases the process of refining is dispensed with, and the raw or crude pigs are at once carried to the puddling-furnace, and there boiled, and puddled and balled; and further, malleable-iron has been produced in puddling-furnace directly, from the melted iron from the blast-furnace, and in other instances, the melted iron from the

Specification of the Patent granted to WILLIAM FOTHERGILL COOKE, of Breed's Place, Hastings, in the County of Sussex, Esquire, for Improvements in Giving Signals and Sounding Alarums at distant Places, by means of Electric Currents transmitted through Metallic Circuits.—Sealed April 18, 1838.

(Continued from p. 149.)

And in case a line of railway road is to be provided with an apparatus for giving signals and sounding alarums at distant places along such line by means of electric currents transmitted through metallic circuits, the long conducting or telegraphic wires being extended along such line of railway, whereon stations at suitable distances may be provided with terminal apparatuses, as at fig. A, and fig. b, sheet A; and also intermediate apparatuses; as at fig. T, may be provided, wherever they can be required, on such line, between those said terminal apparatuses, either as mere duplicates of the apparatus for giving signals and sounding alarums, to operate simultaneously with, and similarly to, the two terminal apparatuses to which they are intermediate, as is described in the former specification; or else such intermediate apparatuses (or so many of them as is desirable) may have all the provisions hereinbefore explained, in reference to figs. T, Pa, p, m, l, la, and k, sheet A, for enabling persons stationed at any of the intermediate apparatuses which are so provided, to give signals or sound alarums at either one of the said terminal apparatuses, as well as at other intermediate apparatuses which may intervene between that one terminal apparatus aforesaid, and the said particular intermediate apparatus so provided as aforesaid, from which the signal is given or alarum is sounded.

And further, in case it is thought desirable to provide the means of establishing, for a time, a temporary and occasional mutual telegraphic communication from almost any part of a long line of railway road, to either one of

the two nearest terminal apparatuses, and intervening intermediate apparatuses, then a portable apparatus for giving signals, having its set of buttons and finger-keys, and its voltaic battery, may be adapted to be packed in a suitable case, and carried with any train of carriages, so as to be ready for use, at any time, and at nearly any place, along the line, in case of accidents or stoppages or other events occurring, which may render it desirable to open a mutual telegraphic communication with the several stations on the line, or some of them, where terminal or intermediate apparatuses are established as above stated. And in such case the said portable apparatus is to be suitably (but temporarily) connected with the telegraphic wires (or with part of them) at some convenient place along the line, which has been provided at the time of laying down the telegraphic wires, with adequate means for making such temporary connections whenever the same should become requisite ; and such places may be at or near every mile post, or every half-mile post, or quarter-mile post, or under the bridges nearest thereto, or other suitable places along the line, so as to offer the means of connecting a portable apparatus with the telegraphic wires, within a reasonable distance of any place along the line where an accident or stoppage or other event may occur, and render it desirable to establish, for a time, a mutual telegraphic communication with some of the stations on the line.

A portable apparatus and means which may be provided for connecting it, when required, with the telegraphic wires, is represented in sheet B.

The portable apparatus itself, figs. *d, e, f, g, t, u, x*, in that sheet, is for the most part of the same construction as the intermediate apparatus, figs. *τ, t, u*, and *x*, sheet A, already described, but it has only two needles, which are adapted to give eight signals, and it is connected with only three of the long conducting or telegraphic wires ; nevertheless, that difference is not essential to a portable

apparatus, for it might be constructed with four needles, the same as the intermediate apparatus, fig. *r*, sheet *A*.

The means provided at every quarter-mile or other post, or under the bridges nearest to the same, are represented in figs. *q*, *r*, *s*, *n*, *y*, and *z*, sheet *B*. The five, six, or other number of long conducting or telegraphic wires, 21, 22, 23, 24, and 25, fig. *q*, in proceeding on their horizontal course along the line of railway road (as shewn along the bottom of sheet *B*) are deflected laterally therefrom, and carried upwards, as at 9, within a hollow in the mile post, or other suitable post, where such means are to be provided, or within a metal pipe or tube, 9, fixed within such hollow, or within the brick or stone-work of the pier of a bridge, or other wall; so that by one or other such means the conducting or telegraphic wires are caused to go up into a hollow box, 15, figs. *q*, *r*, *s*, which is firmly fixed at the top of such post, or which is embedded into the brick or stone-work of such pier or wall, and then from the interior of such box a continuance of the wires descend again, within the said hollow or tube, 9, (or else within another such, side by side therewith) in order to resume their proper horizontal course, along the line of railway or road.

The means of connexion now to be described are contained within the said box, 15, which must be made to shut very close, with any suitable kind of lid or door, 16, which is capable of being locked, so as to protect the contents of the box from injury or wet, and a key or keys, capable of opening such locks must be carried with the portable apparatus. The box, 15, may be conveniently made of cast iron, of any suitable form, but if it has a circular doorway into it (as shewn in figs. *q*, *r*, *s*, *n*, *y*, *z*,) the door or lid, 16, may be the more easily made to fit close, by turning in a lathe; the circular door or lid, 16, may be a dish, with its prominent rebated border, closely fitted into an internal rebated border, around the circular doorway, as shewn in the horizontal section, fig. *n*, of

the box, and the lock may be an internal turning cross-bar, 29, fixed to a short axis, 28, sunk in a key-hole, in the centre of the door, 16, and forming a diameter to the circle, but somewhat longer than the interior diameter of the circular doorway of the box, 15; and when the door is in the act of being applied in place, the two ends of the turning cross-bar, 29, are admitted into two notches, which are cut in the doorway for the reception of those ends, and then, by a suitable key, inserted from the outside of the door into the key-hole, in its centre, to fit on the end of the axis, 28, of the cross-bar, 29, the same may be turned round, so as to carry its said ends from the said notches, into a circular groove, which is formed around the inside of the circular door-way, and after that, (when the key is withdrawn from the key-hole) the cross-bar, 29, will hold by its ends in the said groove, so as to retain the door, 16, securely in place, against any accidental or intentional violence, but at any time, on applying the key to the axis, 28, and thereby turning the cross-bar, 29, round as far as suitable stops, fixed to the door, 16, will permit it to go, then the two ends of the cross-bar, 29, will come to those parts of the circular groove, where the two notches before-mentioned are cut in the door-way, so as to allow those ends to come out of the groove, when the door, 16, is opened. The door may be hung on a hinge for opening, or it may be wholly removed, in order to open the box, 15, in which case there must be some steady pin or stud, in the circular fitting of the door, 16, into its door-way, in order to guide the door, and the ends of the cross-bar, 29, into place, when the door is to be closed. The key should fit upon some particular shaped end of the axis, 28, of the cross-bar, 29, and that end should be wholly sunk into a socket within the keyhole, as shewn in fig. *n*, so as not to be accessible by any other instrument than the proper shaped key, and that key should have a projecting stud, or studs, to enter into a circular internal groove within the key-

hole, so as to retain the key from being withdrawn from the key-hole, unless the cross-bar, 29, is turned to the position in which it locks the door, all which may be on the same system as the keys commonly used for what are called lock-cocks, for drawing off beer from casks; and all the boxes, 15, along all the line should be capable of being opened by one or other of a few such keys, which are to be carried with the portable apparatus. The telegraphic wires which come up at 9, fig. *q*, into the interior of the box, 15, as before mentioned, are severally connected to as many metal screw-pins, 71, 72, 73, 74 and 75, which are fixed in a vertical row, one above another, in a piece of wood, *y*, contained and fastened into the box 15, the said several screw-pins being quite insulated one from another by the non-conducting quality of the wood, *y*, into which they are all fixed, and they project out horizontally therefrom. The said screw-pins, 71 to 75, are connected to the ends of the several telegraphic-wires, which come up at 9, into the box 15; and there is another like row of pins, 81, 82, 83, 84 and 85, fixed into the same wood, *y*, and the latter pins are connected to the ends of the several telegraphic-wires which go out from the box, 15. The ends of all the several wires are twisted into eyes, which are applied around the several screw-pins, so as to form suitable metallic contacts, but each wire and pin is kept insulated from all the other wires and pins. Short pieces or links of wire, 38, 38, each bended into an eye at each end, are applied with those eyes over the said screw-pins, so as to reach horizontally from each pin of one row to the corresponding pin of the other row; those links are all insulated one from another, and they form the continuity of metal of each telegraphic-wire, 21, 22, 23, 24, 25 and 26, in its passage through the box, 15. A small nut which is screwed upon the screw-thread of each pin, 71 to 75, and 81 to 85, presses upon the eye of the wire-link, 38, and upon the eye at the end of the telegraphic-wire, so as to

ensure an effectual metallic contact and continuity of each of the telegraphic-wires.

All the several boxes, 15, along the line being as above described, are kept shut and locked, and they will have no effect on the transmission of electric currents through such of the conducting-wires as may for the time be formed into metallic circuits; for such electric currents, in passing through any one of the wires, will go from the long horizontal line thereof up that portion of the wire which ascends at 9, fig. *q*, into the box to one of the screw-pins, 71 to 75, belonging to that wire, and from that pin through the horizontal wire-link, 38, to the other corresponding screw-pins, 81 to 85, belonging to the same telegraphic-wire, and thence passing down through that portion of the wire which descends at 9, from the box, 15, to the continuation of the long horizontal line, as shewn in fig. *q*. And whereas in so passing through the box, 15, each telegraphic wire preserves its own course of metallic continuity and is kept insulated from each of the other wires as well as from all parts of the box, 15, the transmission of electric currents will take place through all the length of each of the wires, as readily as though the several wires continued along their usual horizontal course, as shewn at the bottom of sheet B, without ascending therefrom, at 9, into each box, 15, and then descending again, at 9, from that box to continue along the horizontal course, because the wire-links, 38, within the box, 15, preserve the metallic continuity of each telegraphic wire in its course through the box.

And whenever it is required to connect the portable apparatus with the telegraphic wires, or some of them, the door, 16, of that box, 15, which is nearest at hand, being unlocked and opened, or removed, the horizontal wire-links, 38, 38, are cut with a chisel, or pair of nippers, or otherwise removed, so as to break the aforesaid metallic continuity of each telegraphic wire, or rather of so many thereof as the portable apparatus is to be connected with,

which, if it is constructed as represented in sheet B, will be only three in number, and those three may be the wires, 21, 22, and 23, which are connected by the three uppermost links, 38, of those in the box, 15, and those three wires, 21, 22, and 23, thereby become divided into two distinct portions, whereof one portion forms a metallic continuity extending from the box, 15, to one of the terminal apparatuses, and the other portion a like metallic continuity extending from the same box to the other of the terminal apparatuses. This being done, a new connexion is established with the wires (that have been so interrupted) by means of a piece of wood, 56, figs. *r*, *y*, and *z*, which is carried with the portable apparatus, as a part thereof; it has metal springs, 61, 62, 63, and 64, 65, 66, fixed to it, and projecting out laterally each way, so that when the piece of wood, 56, is inserted in place into the box, 15, as shewn in figs. *r*, *y*, and *z*, those springs correspond to the several wire-links, 38, 38, whereof some have been just before removed, and the end of each spring, 61 to 66, will apply, with a close metallic contact, to the outermost or projecting ends of the screw-pins, 71 to 75, and 81 to 85, of those links which have been removed. And in order to guide the piece of wood, 56, truly into its place, when it is in the act of being fixed into the box, 15, it has three stumps, 40, projecting from a slight iron bar, which forms a back to the wood, 56, and those stumps enter into three corresponding holes, in the wood, *y*, which is fixed into the box, 15, and the piece of wood, 56, is retained in place, by means of a slight turning cross-bar, 39, which is fitted on a centre pin, in the back bar of the piece of wood, 56, and answers to the turning cross-bar, 29, which, as already described, forms the lock of the door 16; the two ends of the cross-bar, 39, are admitted into those two notches which are cut, as before mentioned, in the circular door-way, when the stumps, 40, of the piece of wood, 56, are in the act of being inserted into their holes and then the cross-bar, 39, being turned about its centre

pin by means of its handle, 76, which projects out from it for that purpose, as shewn in figs. *r*, *y*, *z*, the ends of the cross-bar, 39, are carried from the said notches into the circular groove before mentioned, and as shewn in fig. *r*, so as to lock the piece of wood, 56, with its springs, 61 to 66, into their intended place. And note, the springs, 61, 62, and 63, which project out one way from the piece of wood, 56, have no metallic continuity of connection with the corresponding springs, 64, 65, and 66, which project out the other way therefrom, but all the several springs are kept insulated one from another by the wood, 56, to which they are all affixed, and a set of three conducting-wires, 67, 68, and 69, proceed one wire from each of the springs, 61, 62, and 63, which project from one side of the piece of wood, 56, and extend any convenient length therefrom to reach to the portable apparatus, where they are connected to three screw-buttons, 21*m*, 22*m*, and 23*m*, figs. *d* and *f*, which project from the outside of the case or box thereof. Also three other like conducting wires, 77, 78, and 79, proceed from the other springs, 64, 65, and 66, which project on the opposite side of the piece of wood, 56, and those wires are connected to three other screw-buttons, 21*g*, 22*g*, and 23*g*, of the portable apparatus. The said screw-buttons, 21*m*, 22*m*, 23*m*, and 21*g*, 22*g*, 23*g*, which project from the outside of the case, are in fact milled thumb-nuts, screwed upon projecting screws, and the ends of the several branch wires, 67, 68, 69, and 77, 78, 79, which are to be connected to them respectively, are terminated with small tags or forked pieces of metal, which being applied on the said screws, and the nuts or buttons screwed tight, they bind the forked tags so as to make the metallic contact complete between the wires and the screws on which the buttons are screwed. The said screws enter into the box or case, figs. *d*, *e*, *f*, *u*, *t*, of the portable apparatus to the interior thereof, and are there connected by means of wires to a suitable current director contained in the case, and hav-

ing nearly the same properties as that hereinbefore described as belonging to the intermediate apparatus, sheet A, and the current-director might be constructed in the manner of a lever, capable of being tilted up or down, about a centre of motion, as hereinbefore described; or otherwise, it may be constructed in the manner of an axis mounted on pivots, and capable of being turned half round. The portable apparatus represented on sheet B, is constructed in the last-mentioned manner, the current-director, *f*, figs. *f*, *u*, and *g*, being a horizontal axis of wood, *f*, whereof one end projects out through the right-hand end, fig. *e*, of the box or case, and has a lever handle or index, *g*, figs. *e*, *f*, *t*, *x*, and *g*, fixed upon it, to enable the operator to turn the axis half round. When the index, *g*, is turned so as to point upwards, then by medium of the current-director, *f*, and its accessories within the case, the coils of wire around the magnetic-needles of the portable apparatus, and the finger-keys thereof, and also its voltaic battery, become duly connected with one of the portions into which the three long conducting or telegraphic-wires, 21, 22, and 23, have been divided by the removal of their wire-links, 38, from within the box, 15, as already stated, the connections being such as will qualify the portable apparatus for carrying on a mutual telegraphic communication with that terminal apparatus, to which the said portion of the telegraphic-wires extend. But on the contrary, if the index, *g*, is turned half round so as to point downwards, then the current-director, *f*, causes the coils of the needles of the portable apparatus and the finger-keys, and voltaic battery thereof, to become duly connected with the other portion into which the said three long telegraphic-wires have been divided, as aforesaid, the connections being such as will qualify the portable apparatus for carrying on a mutual telegraphic communication with that terminal apparatus, to which the said other portions of the telegraphic-wires extend. Or, if the index, *g*, is turned so as to point in a horizontal di-

rection, (intermediate to the aforesaid positions of pointing upwards or pointing downwards,) then each of the said three long telegraphic-wires becomes re-connected into one long continuity of metal, extending from one terminal apparatus to the other, but nevertheless the coils of wire around the magnetic needles of the portable apparatus still remain connected, so as to form part of that continuity, but now those coils are at a middle part of the length of the long continuous extension, instead of being, as they were in the two preceding cases, at the termination of one or other of two portions into which that length was then divided ; but the finger-keys of the portable apparatus, and also its voltaic battery, become wholly disconnected from the telegraphic wires, when the index, *g*, is in its aforesaid intermediate position ; and in this state the portable apparatus will operate as a duplicate apparatus, containing needles, which always give the same signals as are given by the corresponding needles of the two terminal apparatuses, between which the portable apparatus is situated. The manner whereby the current-director, *f*, operates to produce the requisite changes of the connections for the aforesaid purposes, is similar to that of the current-director hereinbefore described in reference to sheet A, notwithstanding the apparent differences in the construction and arrangement of the parts. To explain the differences, the course of the metallic continuity of the long telegraphic wires through the apparatus now describing must first be traced, supposing the index, *g*, of the current-director, *f*, to point horizontally, or to be in its intermediate position. The three branch wires, 67, 68, 69, figs. *r*, and *d*, sheet B, have been already explained to be prolongations of the metallic continuity of those three long telegraphic wires, 21, 22, 23, which have had their connecting-links, 38, 38, 38, within the box, 15, fig. *s*, cut or removed, the said continuity of those branch wires being obtained by the contact of the springs, 61, 62, 63, figs. *r* and *y*, with the ends of the screw-pins, 71, 72,

73, fig. *s*, as already explained. The forked-tags at the ends of the branch wires, 67, 68, 69, being joined to the buttons, 21*m*, 22*m*, 23*m*, figs. *d* and *f*, at the outside of the case of the portable apparatus, wires, 21*a*, 22*a*, 23*a*, figs. *f* and *g*, proceed within the case from those buttons to three pins, which project upwards from a piece of wood, *o*, which is fixed horizontally in the case, parallel to the horizontal axis, *f*, of the current-director : upon the upper ends of the said pins, the ends of three metal springs, 21*b*, 22*b*, 23*b*, press down with close contact, so as to prolong the metallic continuity of the wires, through those springs, which are fixed by their other ends to the wood-work of the box, and from those fixed ends of two of the springs, 21*b*, and 22*b*, ascending-wires, 21*c*, 22*c*, are connected, and those wires form the coils, 8, 8, fig. *f*. around the magnetic needles, 1 and 2, of the portable apparatus, and after completing the said coils, the other ends of the same wires descend at 21*d*, 22*d*, and are connected to two other springs, 21*e*, 22*e*, which are similar to the springs before-mentioned, but inverted ; for these press upwards beneath the ends of the two pins which project downwards from the same fixed piece of wood, *o*, and from those pins, wires, 21*f*, 22*f*, proceed to the buttons, 21*g*, 22*g*, at the outside of the case. And note, the course of the wire, 23, which has been already traced along with the other two wires, as far as the spring, 23*b*, is the same as those other wires, excepting that it does not form coils around any magnetic-needle, but the wire which is connected to the fixed end of the spring, 23*b*, proceeds, as shewn at 23*dc*, fig. *f*, to connect at once with an inverted spring, 23*e*, which stands side by side, with the other two such springs, 21*e*, 22*e*, before-mentioned ; and the end of the spring, 23*e*, presses upwards, with contact beneath the end of a pin, which projects downwards from the piece of wood, *o*, and from that pin a wire, 23*f*, proceeds to the button, 23*g*. And the three buttons, 21*g*, 22*g*, 23*g*, are connected to the branch wires,

77, 78, 79, which extend from those buttons to the box, 15, fig. *r*, and there by their connection with the springs, 64, 65, 66, and by the contact of the ends of those springs with the ends of the pins, 81, 82, 83, fig. *s*, the course of metallic continuity is prolonged to those parts of the long telegraphic-wires, 21, 22, 23, where they descend, at 9, to continue their horizontal course, as is shewn in fig. *q*. The current-director, *f*, whereof the axis extends horizontally across and between the three upper springs, 21*b*, 22*b*, 23*b*, and the three lower or inverted springs, 21*e*, 22*e*, 23*e*, has no effect whatever when it is in its intermediate position, as it now stands; but when its index, *g*, is turned to point upwards, then three pins which project out from its axis, *f*, on the same side of the centre thereof as the index, *g*, projects therefrom, are brought into contact with the undersides of the springs, 21*b*, 22*b*, 23*b*, in order to bend those springs upwards, so much as will detach their extreme ends from their previous contacts with the projecting pins in the piece of wood, *o*. Or if the index, *g*, is turned so as to point downwards, then the same three projecting pins in the axis, *f*, are brought into contact with the upper sides of the springs, 21*e*, 22*e*, 23*e*, in order to bend those springs downwards so much as will detach their ends from their previous contacts with the pins which project downwards from the piece of wood, *o*. And it is by thus detaching the previous contacts that the metallic continuity of each of the long telegraphic-wires becomes divided into two portions, as aforesaid. But when the index, *g*, points horizontally, the said three projecting pins in the axis, *f*, do not form any contacts whatever, and the long telegraphic-wires preserve their metallic continuity through the portable apparatus, in the manner already explained. The three pins in the axis, *f*, are connected by wires, 91, 92, 93, with the finger-keys, 31, 32, 33, by which means it follows that whenever the pins in the axis, *f*, are brought in contact with either set of the said springs (whether above

or below the axis, *f*,) in order to bend them away from their former contacts, as aforesaid, the new contacts which are so formed will connect the said springs with the finger-keys by intervention of the pins in the axis, *f*, and the connecting-wires, 91, 92, 93, which extend from those pins to the finger-keys. And note, the said connecting-wires, 91, 92, 93, are curled in the manner of spiral wire-springs at some part of their length, in order that they may be qualified to bear extension in length, when the axis, *f*, is turned in that direction which tends to wind them up around it by its motion ; and also by the elasticity of the said curled portions the wires will preserve a sufficient tension to keep them one out of the way of another, when the motion of the axis, *f*, is in that direction which tends to unwind the wires from around it. The operation of the current-director, *f*, will be rendered more intelligible by considering the before-mentioned projecting pins in the fixed piece of wood, *o*, as the terminations of the two portions into which the long telegraphic wires are to be divided, viz., the said pins which project upwards from the piece of wood, *o*, being considered as the terminations of those portions of the telegraphic-wires which extend from the portable apparatus in one direction, and the other such pins which project downwards from the piece of wood, *o*, being considered as the terminations of those other portions of the telegraphic-wires which extend from the portable apparatus in a contrary direction ; also, considering the springs which are to form the contacts with the said pins in the piece of wood, *o*, as the terminations of the coils of wires, 8, around the magnetic needles, 1 and 2, viz. the upper springs, 21*b*, 22*b*, being one end of each of such coils, and the lower inverted springs, 21*e*, 22*e*, being the other end of each of the same coils ; and also, considering the three pins in the axis, *f*, as the terminations of the finger-keys, 31, 32, 33. And by thus considering the several parts, and then comparing them with the corresponding

parts of the current-director represented in sheet, A, and hereinbefore described, and by considering the latter in the same manner, the similarity of operation of the two forms of the current-director with their accessories will become evident. The same letters of reference are used to denote the several parts in sheet B, as were used to denote the corresponding parts in sheet A, in order to facilitate the identification of corresponding parts in the two sheets. The voltaic battery belonging to the portable apparatus, sheet B, being properly charged for use, has its two poles connected by wires to the two buttons, 27, 37, at the left hand of the case (see fig. *d*); and each of the wires which proceeds from those buttons withinside of the case, divides into two branches, as is shewn in fig. *f*. One branch of the wire, 27, is connected to a spring, 27*a*, and the other branch to a like spring, 27, the former spring being above and the latter below the axis, *f*, of the current-director; also one branch of the other wire, 37, is connected to a spring, 37*a*, above, and the other branch to a spring, 37, below the axis, *f*. The axis, *f*, has two projecting pins fixed into it on the opposite side of its centre to that side thereof from which the index, *g*, projects; and when the index, *g*, is turned so as to point downwards, then the said two pins are brought up in metallic contact with the two aforesaid springs, 37*a*, 27*a*, which are above the axis, *f*, and the said two pins in the axis, *f*, are connected by wires, 97 and 87, with the two pole-bars, 26 and 36, of the finger-keys of the portable apparatus, some part of each of those wires being curled, as already mentioned respecting the wires 91, 92, 93. Note, those pole-bars and finger-keys, as represented in sheet B, are on a different construction to those described in the former specification in reference to sheet 1 thereof, and also represented in fig. *pa*, sheet A, of this specification, but that difference is not peculiar to the portable apparatus; for the same might have its finger-keys and their pole-bars constructed in the manner

of the intermediate apparatus, represented in sheet A; or, on the other hand, the same kind of finger-keys and pole-bars as are represented in sheet B, (and now about to be explained) might be used for any apparatus, whether terminal, or intermediate, or portable. The finger-keys in sheet B, are small levers, 51, 41; 52, 42; 53, 43; each one being poised on a distinct centre-pin of its own, and the fingers are applied to one or other of the ends of those levers in order to press down that end, and so tilt or incline the lever one way or other, as is shewn at 51, 41, or at 53, 43; and the parts are so arranged that, when a finger-key is thus inclined, the needle which corresponds to that finger-key will, in consequence, be inclined about its own centre in the same direction as the finger-key is inclined about its own centre. The centre-pins on which the said levers or finger-keys are mounted, are sustained in small metal frames affixed to the wood-work of the case, each such frame being kept insulated from its neighbour; and from each lever a short arm descends through the said frame below the centre, the arm being prolonged downwards by a small blade of watch-spring, 31, 32, 33, which is retained near its lower end in a narrow cleft between two pins or studs which are fixed into the wood-work of the case; wherefore the said spring, being straight when left to itself, always tends to hold the key in a horizontal position, as shewn by 52, 42, with its two ends equally elevated; but when by pressure of a finger on either of those ends, the key is inclined either way, the spring, 31, is thereby bended one way or other, as is shewn by 51, 41, or 53, 43. The lower end of each watch-spring, when the same is straight, and its key horizontal, reaches down below its two fixed pins or studs, before mentioned, into contact with a spring which is affixed to a horizontal metal cross-bar, 17, which extends beneath all the keys, and forms a connection of metallic continuity between them all, so long as they continue to be horizontal; but whenever either end of any key is

pressed down, then by the consequent flexure and shortening of the watch-spring of that key, the lower end is drawn so much upwards between its fixed pins or studs as to quit contact with the spring of the cross-bar, 17, thereby disjoining the said key from its previous connection with all its other fellow keys, and at the same time that end of the key which is so depressed comes down in contact with the upper end of a fixed upright pin, which stands up from one of the two pole-bars, 36, or 26, which are connected with the two opposite poles of the voltaic-battery belonging to the portable apparatus. The said fixed upright pins serve as stops to limit the inclination of the keys; and in all cases of pressing the finger on either end of a key, the pressure must be continued until that end of the key is pressed down into effectual contact with the said stop-pins, because by means of that contact the key becomes connected with the battery. The two pole-bars, 26 and 36, are supported by horizontal pillars reaching out from the wood-work of the case, and from each of those pillars one of the said fixed upright pins ascends to stand up beneath one end of one of the keys; and the parts being arranged as shewn in fig. *t*, all the said fixed pins which ascend from the supporting pillars of the pole-bar 26, stand up beneath the right-hand ends, 41, 42, 43, of the several keys, and all the pins which ascend from the supporting-pillars of the pole-bar 36, stand up beneath the left-hand ends, 51, 52, 53, of the several keys. The two pole-bars, 26 and 36, with the several upright pins which stand up from each bar, are quite distinct, and have no connection one with the other, the wood-work by which they are both supported keeping them insulated. Each of the keys is connected to a wire, 91, 92, 93, before mentioned. Those wires extend from the three pins which project out from the wooden axis, *f*, of the current-director, as shewn in fig. *u*, part of their length being curled in the manner of spiral springs, as already stated. The said wires, 91, 92,

93, are connected to their several keys near to their centres of motion, so as not to be much affected by the tilting motion of the keys. Note, the same numbers of reference have been used to denote the several parts in the aforesaid description of the finger-keys, figs. *t* and *x*, sheet B, as were used in the former specification to denote the corresponding parts in the description of the finger-keys, (figs. H, I, and J, sheet 1, thereof) and by comparison, it will be found that the operation of both kinds of finger keys is in effect the same, notwithstanding the difference of their construction. The same action of depressing one end of the tilting lever-key, in sheet B, which disjoins that key from its previous connection by its blade of watch spring with the cross-bar, 17, also brings the depressed end of the key in contact with one of the pole-bars of the battery; wherefore one end of each lever-key answers to one of the two buttons, with which each of the keys described in the former specification, in reference to sheet 1 thereof, is provided; and the other end of each lever-key answers to the other of those two buttons. Note, when the index, *g*, of the current-director, *f*, is turned to point horizontally, being then in its intermediate position, the tail end of the index, *g*, is detained in that position, by lodging in a notch, in a spring catch, *h*, fig. *e*. The portable apparatus, sheet B, when required for use, may be set up upon its own packing case, by way of a temporary support, and the connecting-wires, 67, 68, 69, and 77, 78, 79, are of such length as will be most convenient to enable them to reach from the portable apparatus, to the box, 15, which (as before stated) is fixed on the top of some post, or embedded into some wall or pier of a bridge, so as to stand by the road-side; and the door, 16, of the box being unlocked, is opened, in order to insert the piece of wood, 56, which belongs to the portable apparatus, and is connected therewith by its wires, 67, 68, 69, and 77, 78, 79, which wires may, for convenience, be bound together into one bundle, their respective

coverings keeping them insulated one from another. The three uppermost wire-links, 38. fig. *s*, being cut out, and removed, in order to divide the long metallic continuity of each of the three telegraphic-wires, 21, 22, 23, into two portions, then the piece of wood, 56, is mounted in its intended place, in the box, 15, and fixed therein, by turning its cross-bar, 39, as is seen in figs. *r*, *y*, *z*; wherefore the springs, 61, 62, 63, and 64, 65, 66, by applying in close contact with the ends of the screw-pins, 71, 72, 73, and 81, 82, 83, fig. *s*, connect the portable apparatus with the said three telegraphic-wires, because the wires which extend to the portable apparatus (and into the interior thereof) form prolongations of the metallic continuity of the two portions, into which each of the said three telegraphic-wires has been divided, by the removal of their wire-links, 38. And the coils of wires around the two magnetic-needles, 1 and 2 of the portable apparatus are parts of the said prolongations, but the connections or disconnections of the metallic continuity of the telegraphic-wires, or of either of the portions thereof, with those prolongations, is for the present become entirely dependent upon the current-director, *f*. The voltaic battery belonging to the portable apparatus, being properly charged, has its two poles connected by wires to the two buttons, 27, 37, figs. *d*, *f*, at the end of the box. All the circumstances hereinbefore explained, respecting the construction of the portable apparatus, being kept in mind, and the requisite preparations for using the same being made, as above described, (and which may be done in a very short time) its operation is as follows: In case it is required to open a mutual telegraphic communication between the portable apparatus and that terminal apparatus, which is situated in a direction towards the right hand of sheet B, then the index, *g*, is to be turned, so as to point downwards, as represented in the figures. The metallic continuity of the three long conducting-wires, 21, 22, 23, is thereby broken, in consequence of the

separation of the three lower springs, 21*e*, 22*e*, 23*e*, from their previous contacts with the three pins, 21*f*, 22*f*, 23*f*, which project downward from the piece of wood, *o*.

(*To be continued.*)

NOTICE OF EXPIRED PATENTS.

(*Continued from p. 185.*)

GEORGE WYCHERLEY, of Whitchurch, Shropshire, Saddler, for certain new and improved methods of making and constructing saddles and side-saddles.—Sealed December 7, 1824.

ROBERT DICKENSON, of Park Street, Southwark, Surrey, for an improved air-chamber, for various purposes.—Sealed December 7, 1824.

JOHN THOMPSON, of Pembroke Place, Pimlico, and of London Steel Works, Thames Bank, Chelsea, for an improved mode of making refined, or what is commonly called cast steel.—Sealed December 9, 1824.

ROBERT BOWMAN, of Aberdeen, Scotland, Chain Cable Maker, for an improved apparatus for stopping, releasing, and regulating chain and other cables of vessels, which he denominates Elastic Stoppers.—Sealed December 9, 1824.

WILLIAM MOULT, of Lambeth, Surrey, Engineer, for an improvement or improvements in working water-wheels.—Sealed December 9, 1824.

Sir WILLIAM CONGREVE, of Ceoil Street, Strand, Middlesex, Baronet, for an improved gas-meter.—Sealed December 14, 1824.

SAMSON DAVIS, of Upper East Smithfield, Middlesex, Gun Lock Maker, for an improvement or improvements applicable to guns and other fire-arms.—Sealed December 18, 1824.

DAVID GORDON, of Basinghall Street, London, Esquire, for certain improvements in the construction of carriages or other machines to be moved or propelled by mechanical means.—Sealed December 18, 1824.—(*For copy of specification, Vol. 1, third series, p. 28.*)

SAMUEL ROBERTS, of Park Grange, near Sheffield, Yorkshire, Silver Plater, for an improvement in the manufacture of plated goods of various descriptions.—Sealed December 18, 1824.—(*For copy of specification, see Repertory, Vol. 4, third series, p. 197.*)

PIERRE JEAN BAPTISTE VICTOR GOSSET, of Clerkenwell Green, Middlesex, for certain improvements in the construction of looms or machinery for weaving various sorts of cloths or fabrics.—Sealed December 18, 1824.—(*For copy of specification, see Repertory, Vol. 1, third series, p. 227.*)

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named iron as the material of which such sub-marine vessels should be made, and although I prefer that material, yet other materials might be used, provided the requisite strength and floating properties be obtained, for it is obvious that my invention does not relate to the materials of which the sub-marine vessels are constructed, nor to the precise shape or dimensions shewn and described, as variations may be made, provided the principle of my invention be retained.

Having thus described the nature of my invention, I do not claim the mode of getting a chain or chains around the sunken vessel, as herein described, nor the blocks, chains, or other well-known mechanical means used. But I claim as my invention the construction and application of the sub-marine vessels, as herein described.—In witness whereof, &c.

Enrolled December 22, 1838.

Specification of the Patent granted to WILLIAM FOTHERGILL COOKE, of Breed's Place, Hastings, in the County of Sussex, Esquire, for Improvements in Giving Signals and Sounding Alarums at distant Places, by means of Electric Currents transmitted through Metallic Circuits.—Sealed April 18, 1838.

(Concluded from p. 249.)

If (as before mentioned) those three pins are considered as the terminations of those portions of the telegraphic wires which extend to that terminal apparatus, which is situated towards the left hand in sheet B, it is obvious that the said terminal apparatus is become disconnected by the aforesaid separation of the springs from the pins ; but the coils of wires around the magnetic needles, 1 and 2, of the portable apparatus, continue in connection with the terminations of the other portions of the telegraphic wires, which extend to the right-hand-most terminal apparatus,

those coils being prolongations of those portions. Also, as that separation has been effected by the three projecting pins in the axis, *f*, and those pins respectively being connected by their wires, 91, 92, 93, figs. *u* and *g*, with the three finger-keys, 31, 32, 33, it is obvious that the finger-keys are become connected with the prolongations of those portions of the divided telegraphic wires which extend to the right-hand-most terminal apparatus. Note, the other two pins which project out of the axis, *f*, and which are in connection by their wires, 97 and 87, with the pole-bars, 36 and 26, of the finger-keys (see figs. *f*, *g*, and *t*,) have come up in contact with the two uppermost springs, 37*a*, 27*a*, which by branches of the wires, 37, 27, are in connection, as before stated, with the two poles of the battery of the portable apparatus. Note, the course of metallic continuity, which is now established from each of the finger-keys of the portable apparatus, is as follows; for instance, from the spring-blade key, 31, along the wire, 91, to its pin on the axis, *f*, of the current-director, and therefrom by contact to the lower spring, 21*e*, and thence along the wire, 21*d*, which forms a series of coils, 8, around the magnetic needle, 1, of the portable apparatus; and after those coils then joins by the wire, 21*c*, to the upper spring, 21*b*, and therefrom by contact to the pin, 21*a*, which projects upwards from the piece of wood, *o*, and thence along the wire, 21*a*, to the button, 21*m*, and, therefrom, along the wire, 67, fig. *d*, to the spring, 61, in the box, 15, fig. *r*, and therefrom by contact to the screw-pin, 71, fig. *s*, which is in connection with the long telegraphic wire, 21, at that part thereof which has quitted its horizontal course, to come up at 9, fig. *q*, into the box, 15; but by tracing the wire, 21, from its said pin, 71, down at 9, fig. *q*, to the horizontal course, it will be found to be that portion of the divided wire, 21, which extends to the right-hand-most terminal apparatus. The course from the other finger-key, 32, is similar to the above, and so is the course from the finger-key, 33, excepting that it

does not form any coils around magnetic needles, but instead thereof passes through a short wire, 23*dc*, fig. *f*, from the lower spring, 23*e*, to the upper spring, 23*b*, in lieu of passing through such coils. The portable apparatus in the above positions of its parts (excepting that it has no alarum attached to it) has all the same capabilities for carrying on a mutual telegraphic communication with the right-hand-most terminal apparatus, as the left-hand-most terminal apparatus would have, if the metallic continuity of the three telegraphic wires, 21, 22, 23, had not been broken between those two terminal apparatuses, because, by the very act of breaking that continuity, the portable apparatus is put into the condition of a terminal apparatus in every respect, except having no alarum, and also, in the instance now describing, in having only two needles. It is, therefore, needless to enter into any further explanation of the manner whereby a person, situated at the portable apparatus, can give signals and sound alarums at the right-hand-most terminal apparatus, like signals and alarums being also given and sounded simultaneously at any duplicate apparatuses which may intervene between the portable apparatus and the said terminal apparatus. Or how a person situated at the right-hand-most terminal apparatus can, in return, give signals (but without sounding alarums) at the portable apparatus, like signals being also given, and alarums being sounded, at the aforesaid duplicate apparatuses. For those effects are produced in the same manner as has been already fully explained in the former specification respecting the carrying on of mutual telegraphic communications in reference to fig. *A*, and fig. *b*, sheet I, thereof. Note, it should be incumbent on the person at the portable apparatus to turn the index, *g*, to point horizontally, in order to restore the metallic continuity of the whole length of the telegraphic wires between the two terminal apparatuses, as soon as he has received answers to the communications he may have made to the person at the right-hand-most of those appa-

ratures, because the person at the portable apparatus being only an occasional, and perhaps an unexpected, correspondent, who must necessarily hinder, in part, the ordinary communication between the persons at the two termini, ought not to prolong that hindrance beyond absolute necessity. And when the index, *g*, is placed in a horizontal position, the finger-keys and the voltaic battery belonging to the portable apparatus become wholly disconnected from the three telegraphic wires, and the metallic continuity of those wires is restored through their whole extension between the two terminal apparatuses; but nevertheless, the coils around the needles of the portable apparatus are included in that continuity as part of the said whole extension, whereby the portable apparatus becomes a duplicate apparatus of the first and second needles of the two terminal apparatuses, and will consequently exhibit whatever signals the said first and second needles of those apparatuses exhibit. And in case it is required to communicate from the portable apparatus to the left-hand-most terminal apparatus, then the index, *g*, is turned to point upwards, the metallic continuity of the three wires, 21, 22, 23, is in that case broken by the three pins in the axis, *f*, (which pins belong to the wires, 91, 92, 93, and through those wires to the three finger-keys) pressing upwards beneath the three upper springs, 21*b*, 22*b*, 23*b*, and separating them from their previous contact with the pins, 21*a*, 22*a*, 23*a*, which project upwards from the piece of wood, *o*; and those portions of the horizontal extension of the long telegraphic wires which extend towards the right hand are become disconnected from the portable apparatus, but those portions which extend towards the left hand continue in connection with the coils of wires around the magnetic needles, 1 and 2, of the portable apparatus, which coils form prolongations of the said portions; and the finger-keys, 31, 32, 33, are become connected with those prolongations by the contacts aforesaid of the pins in the axis, *f*, with the springs,

course, in order to ascend at 9, into the box, 15, and then to come down again therefrom at 9, to proceed horizontally again.

And whereas it has been explained in the said former specification (in reference to fig. 8, sheet 11, thereof), how alarms may be sounded at distant places, by means of electric currents transmitted through metallic circuits, and operating (when required) to give angular motion to a magnetic needle, which is disposed within multiplying coils of conducting wire through which (when required) an electric current is transmitted from a distance, the said angular motion of the needle being caused (as therein described) to make the requisite contacts for forming a metallic circuit, whereby an additional voltaic battery, called an alarm-battery, is brought into action when required, for sounding the alarm; I now as part of my present improvements on that mode (instead of using any such additional or alarm-battery) cause the angular motion of such a magnetic needle to remove a detaining detent or stop, of any sufficiently delicate clock or watch-work alarm, so as to allow the wheel-work thereof to be put into motion by the mechanical force and action of its own mechanism, in order to sound the alarm by action of that mechanism. And by this improvement, the necessity of having an additional voltaic-battery or alarm-battery is avoided, which circumstance is particularly advantageous for a portable apparatus, wherein an additional battery for the alarm would be very inconvenient, and hence in the description hereinbefore given of the portable apparatus, in reference to sheet B, it has been stated that the same has no alarm apparatus attached to it; but an alarm apparatus may (according to the improvement now describing) be very conveniently applied in a portable apparatus. The magnetic needle and coils of wire within which it is included, may be constructed as shewn in fig. A, sheet B, being the same construction as described in the former specification, and represented in fig. 8, sheet 11,

thereof, excepting that the end of the slender lever, 63, 64, which is fixed on the axis of the magnetic needle, and which projects out forwards therefrom in the manner described in the former specification, instead of having a fork at its end, 63, to dip into two cups of mercury, as therein described, is straight to the extreme end, 63; and that end, when it descends, strikes down upon the long end, 84, of a very delicate lever detent, 84, 88, belonging to the clock-work or watch-work of the alarum, so as to depress that long end, and thereby remove a very slender arm, 87, of that lever out of the way of the fly, 86, or most rapidly revolving part of the wheel-work of the said clock or watch-work, and that removal will allow the said wheel-work to be put in motion by action of the mechanical force of the clock or watch-work, in order that the same may sound an alarum, because the arm, 87, of the detent lever, 84, 88, is the stop which, when left to itself, rises by the preponderance of the heavier end, 88, so as to bring the arm, 87, which is part of the lighter end, 84, into contact with the said fly, 86, in order to arrest the revolving motion thereof. The construction of the clock-work, or watch-work of the alarum may be of any suitable kind which is in common use in alarum clocks or watches or striking watches, and being well known, requires no particular description. Whenever the magnetic needles of the apparatus, fig. *Æ*, is not influenced by any electric current through the coils, 8, its lever, 63, 64, rises and quits the long end, 84, of the lever detent, 84, 88, and then the heavier end, 88, thereof comes to rest within a notch in the circumference of a small wheel, 85, which is fixed upon the axis of some wheel in the watch or clock-work, whereby that wheel will revolve much slower than the fly, 86, or most rapidly revolving part, which is intercepted as aforesaid by the slender arm, 87, of the detent-lever. And when by transmission of an electric current through the coils, 8, in manner explained in the former specification, in reference to fig. *s*, sheet 11, the magnetic needle is caused to strike down upon the

long end, 84, of the detent, so as to remove the end of its arm, 87, out of the way of the fly, 86, and also to lift the heavier end, 88, out of the notch in the wheel, 85; then the fly, 86, begins to turn rapidly round, and the notched wheel, 85, also begins to turn, but with a slower motion than the fly, and thereby the notch in the wheel, 85, is carried away from beneath the heavier end, 88, of the detent lever, which end will therefore rest on the circumference of the wheel, 85, so as to be prevented from descending again for the present, even although the action of the magnetic needle on the long end, 84, of the detent lever should be discontinued; but the clock or watchwork will nevertheless continue to move and sound an alarm until the motion of the wheel, 85, brings the same (or another like notch) beneath the heavier end, 88, and (provided that the action of the magnetic needle is by that time discontinued) that notch allows the said heavier end, 88, to drop into the notch, so as to bring the end of the arm, 87, into the way of the fly, in order to stop the motion thereof, and of the clock or watch-work. Hence in this way the alarm, whenever it may have been put into action by the magnetic needle, will continue to sound during a certain time, and will not stop until it has sounded so long. The construction and operation of the said wheel, 85, on the detent lever, 84, 88, requires no further explanation, being commonly used in musical snuff-boxes, and well known. And note, the manner of connecting the said alarm apparatus, fig. κ , with any apparatus containing needles for giving signals is to be, by means of the buttons, 75 and 76, in the same manner as explained in the former specification in reference to fig. s, sheet 11, thereof, and hereinbefore described, and in reference to figs. p, l, sheet A. And note, it is not necessary that the apparatus for sounding alarms according to this present part of the improvements should have a distinct magnetic needle of its own, as represented in fig. κ ; for one of the ordinary magnetic needles or pair of astatic needles of

any apparatus for giving signals may be made to answer the purpose. See the dotted lines, figs. *t* and *e*, sheet *B*, which is a portable apparatus, whereof the second needle may have a slender arm, 63, projecting out from its axis, as shewn by dotted lines in fig. *t*, and that arm, 63, may operate in every respect in the same manner as already described respecting the arm, 63, fig. *æ*, upon the long end, 84, of a detent lever, 84, 88, figs. *t* and *e*, which end may come through an opening in the dial-plate, and the heavier end, 88, of the lever, may extend behind that plate, as shewn by the dotted lines in fig. *e*, and have a slender arm, 87, to intercept and stop the fly, 86, of the clock or watch-work which is also placed behind the dial, and the heavier end, 88, may apply to a notched wheel, 85, belonging to the wheel-work, and operating as already described, in respect to the corresponding parts of fig. *æ*. And note, it is obvious that each of the needles of the portable or other apparatus might be provided with a similar arm, 63, and with clock or watch-work alarums of the same kind as last described, so as to render the apparatus capable of sounding two or more kinds of alarums which may be distinguishable one from another by decided differences in their sounds. And note, the said clock or watch-work alarums may be provided with stop detents of the kind commonly used in clock-work and watch-work to prevent the motion of the wheel-work, when it is not required to have alarums sounded.

And whereas it is explained in the early part of the former specification respecting the several magnetic needles, which are to be moved with angular motion about their axes or centres of motion by means of electric currents, that each such needle must have some slight tendency given to it to induce it to point in one particular direction whenever it is left to itself uninfluenced by the electric current, and also that the simplest mode of giving such a tendency is by gravitation, for which purpose one end of the needle may be made heavier than the other, as

already fully explained ; I now employ as part of my present improvements another mode of giving such a tendency, namely, by magnetic attraction, either instead of gravitation, or in aid thereof, for which purpose a small magnet is to be fixed in a suitable position in respect to one end of the magnetic needle for attracting the same into the required particular direction, whenever the needle is not influenced by the electric current ; the proximity of such fixed magnet to the end of the needle, together with the attractive force of such magnet, being suitable for enabling it to command the needle whenever the same is not influenced by the electric current ; but nevertheless, the magnet must not have so much power over the needle as to prevent the same from being moved about its centre of motion (in manner hereinbefore fully described) by action of the electric current, in order to incline or deflect the direction of the needle either way from the aforesaid particular direction which the needle is caused to assume, when uninfluenced by the electric current.

Figs. M, N, and O, sheet A, represent one of the needles, 7, similar to those described in the former specification (in reference to figs. C to G, sheet 1, thereof) and the several parts being designated by the same figures of reference, the description in that former specification is applicable, and need not be herein repeated. *w*, is the small magnet now describing, it may be a small prismatic piece of hardened steel well magnetized, it is held fast in a small brass socket, *y*, which may be affixed to the back of the dial-board, A, with one of its ends situated in the direction which the needle, 7, is required to assume when it is uninfluenced by the electric current. That end of the magnet, *w*, which is towards the end of the needle, 7, must present the contrary magnetic pole of the magnet, *w*, to the magnetic pole of that end of the needle, 7, towards which the said end of the magnet, *w*, is so presented, in order that there may be a mutual magnetic attraction between the end of the magnet, *w*, and the adjacent end

of the needle, 7. For instance, if the magnet, *w*, is fixed opposite to the north pole or end of the needle, 7, then the said magnet, *w*, must present its south pole or end to the said north pole or end of the needle, 7, or *vice versa*. The magnet, *w*, being fastened into its socket, *y*, by a setting screw, and the socket, *y*, being capable of being turned round about its centre, it admits of the magnet, *w*, being placed with its end at such a distance from (and such a position laterally in respect to) the end of the needle, 7, as (according to the vigour of the magnet, *w*, and the balance of the needle) will give the magnet a sufficient and suitable control over the needle, 7, to command the same, and recal it to its intermediate position whenever it is not influenced by the electric current, but without giving the magnet, *w*, a sufficient power over the needle, 7, to prevent the latter from moving promptly in either direction, by action of an electric current (as explained in the former specification): or the action of such magnet may be combined with the gravitating action of a heavy end to the needle, which gravitating action is explained in the former specification, provided that the combined action of magnetic attraction and gravitation be, as before stated, sufficient for commanding the recall of the needle accurately to its intermediate position, without being sufficient to impede the motion of the needle, which will be induced by action of an electric current. Note, this part of my present improvements is particularly applicable to portable apparatuses, but may be also used in fixed terminal and intermediate apparatuses.

And note, respecting figs. M, N, and O, sheet A, I find it most convenient to provide a separate bridge or support, 12, 13, 12, 13, for the screws which contain the pivot-holes for the pivots at the two ends of the axis, 6, of each magnetic needle or pair of astatic-needles; those bridges being fastened by screws to the dial-plate, A, and to the frame, 10, containing the coils of wire. In this way the bridges, 12, 13, for any one needle or pair of astatic needles in an apparatus, can be removed without disturbing the other

needles of that apparatus, which disturbance is an inconvenience if all the needles are sustained as described in the former specification (in reference to figs. A, and C, in sheet 1, thereof) by one horizontal bar, 12, in front of the dial, and another such bar, 12, behind the dial.

And note, the pivot-holes in the said bridges, 12, 13, for the reception of the pivots at the two ends of each axis of the needles, may be jewelled in the same manner as is commonly practised for watch-work.

And note, respecting the stops, 14, figs. M, N, O, sheet A, for limiting the extent of the angular motion of the needles, as explained in the former specification (in reference to figs. D, and E, sheet 1 thereof), I make the said stops, 14, of slender strips of copper-plate, fastened by screws to the frames, 10, containing the coils of wire, and to the extremity of each such copper stop, I affix a small piece of ivory or bone to be presented to the needle, in order to stop its motion easily, without causing the needle to rebound from, or allowing it to adhere to, its stops.

Having now described my said improvements, I the said William Fothergill Cooke do hereby declare, that the new invention whereof the exclusive use is granted to me by the said letters patent of the 18th day of April last, consists in the following particulars. And note, whereas the particulars of improvements which were claimed by me, and Charles Wheatstone, in the former specification, by virtue of our patent of the 12th day of June, 1837, were therein enumerated as "firstly," "secondly," and so on, in due order up to "ninthly;" I shall, in order to avoid confusion therewith, enumerate the several particulars of improvements, which I now claim in this specification, under the heads or titles, "part A," "part B," and so on, as follows:—

Part A is the improvement hereinbefore described and represented in figs. T, Pa, P, p, m, l, la, and k, sheet A, of the drawings hereunto annexed; the improvement being upon a duplicate apparatus, such as is mentioned in the claim at the end of the former specification as the fifth

particular thereof, for exhibiting signals, and sounding alarums at any intermediate place, between the two termini of a long line or extension of combined conducting or telegraphic wires, which are suitable for carrying on a mutual telegraphic communication between appropriate apparatuses at those two termini. My present improvement on such duplicate intermediate apparatus being the means hereinbefore described and represented as aforesaid, in sheet A, by figs. T, Pa, P, p, m, l, la, and k, whereby a set of buttons and finger-keys and a voltaic battery may be added to such duplicate intermediate apparatus, in such manner, and with such arrangements, as that by a suitable manipulation as hereinbefore described, the said long conducting or telegraphic wires, may have their metallic continuity cut off at the said intermediate apparatus, so as to divide the whole length or extension of the said long conducting or telegraphic wires into two distinct portions for a time, one portion extending in one direction from the said intermediate apparatus to the apparatus at one terminus, and the other portion extending in a contrary direction from the same intermediate apparatus to the apparatus at the other terminus : and also that the same manifestation, which so divides the said wires into two such portions, shall connect the ends of either one or other of those portions (whichever of them may be chosen for the time) with the aforesaid set of finger-keys and buttons, wherewith the intermediate apparatus is provided, and shall likewise connect the aforesaid voltaic battery, wherewith that intermediate apparatus is provided, to that said set of buttons and finger-keys, in a suitable manner for qualifying the said intermediate apparatus, to which this present part of my improvements is added, for giving signals and sounding alarums at that terminus, which may have been chosen for the time, as aforesaid ; as well as at any duplicate apparatus which may be provided, as mentioned at the end of the former specification, in the fifth particular of improvement, at any intermediate place between the said terminus and the said intermediate apparatus, to

which this present part, A, of the improvements is added. But nevertheless, that by reversing the aforesaid manipulation in manner hereinbefore described, the metallic continuity of the long conducting or telegraphic wires, which have been so divided for a time into two portions, as aforesaid, may be instantaneously and effectually restored to their whole extension, suitably for carrying on a mutual telegraphic communication between the two apparatuses at the two termini; the set of buttons and finger-keys, and the voltaic battery, wherewith the said intermediate apparatus is provided, becoming instantaneously disconnected from the long conducting or telegraphic wires, by the said reversing of the manipulation aforesaid; but notwithstanding that disconnecting, the said intermediate apparatus being nevertheless qualified (as the intermediate apparatus was described to be in the former specification) for operating simultaneously with the apparatuses at the two ends, as well as with any other duplicates thereof, which there may be at other intermediate places, so as to give like signals and sound like alarums by every apparatus, according to what is stated in the former specification, as the fifth particular of improvement.

Part B is the improvement hereinbefore described and represented in figs. T, and I, sheet A, and also in figs. f, u, and g, sheet B, of the drawings hereunto annexed, whereby the alarum apparatus belonging to any intermediate apparatus, to which part A of the improvements is added, will not be connected with that same portion of the divided conducting or telegraphic wires, wherewith the set of buttons and finger-keys, and voltaic battery, become connected by such a manipulation with a current-director, as is explained respecting part A of the improvements; but on the contrary, the said alarum apparatus will, by such manipulation aforesaid, become connected with the other portion of the divided conducting or telegraphic wires, and thereby the said intermediate alarum apparatus may be sounded from one terminus, whilst the said intermediate apparatus is carrying on, or is pre-

pared for carrying on, a mutual telegraphic correspondence with the other terminus.

Part c is the improvement hereinbefore described and represented in *t, u, x, f, d,* and, *q, r, s, n, y, z,* in sheet B, whereby a suitable portable apparatus for giving and for exhibiting signals, can be temporarily connected with the long conducting or telegraphic wires, or with some of them, at any part of their length, when the means hereinbefore described and represented at figs. *q, r, s, n, y,* and *z,* sheet B, have been previously provided for the purpose of making such temporary connections. Also the improvement of the said means so represented at figs. *q, r, s, n, y,* and *z,* sheet B, and hereinbefore described, for making temporary connections with the telegraphic wires, or with some of them, at any part of their length, where those said means may have been previously provided, when such connections are made as hereinbefore described for the purpose of proving the metallic continuity of the several telegraphic wires, according to the mode of proof explained in the former specification, in respect to the figs. *w,* and *L,* sheet III, of the drawings thereof.

Part d is the improvement hereinbefore described and represented at figs. *q, v, w,* sheet B, for securing and protecting the long conducting or telegraphic wires, by laying the said wires within pipes or tubes of metal, whereof the several lengths or portions are united by screw joints or socket joints, or by soldering, and the several wires being so insulated by their respective non-conducting coverings as to admit of laying side by side within such pipes, and the several wires being either left detached, one from another, within such pipes, or else bound together in a firm bundle, as has been hereinbefore described, in reference to fig. *q,* sheet B; and the collected set of loose wires, or the bundle thereof, being drawn into place within such pipes, or otherwise the pipes being drawn over the wires, in the manner hereinbefore described.

Part e is the improvement hereinbefore described, and

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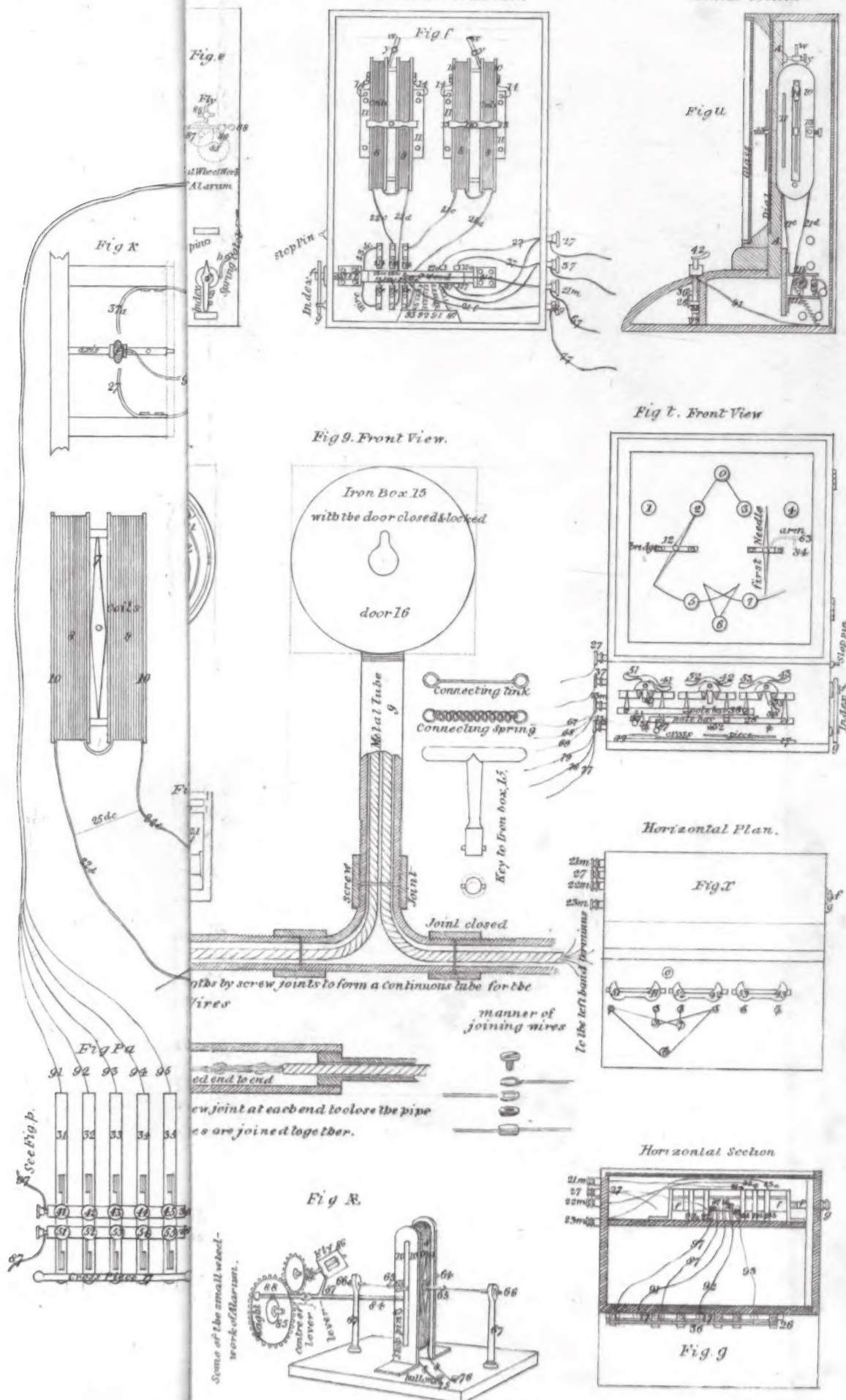
represented in figs. M, N, and O, sheet A, whereby magnetic attraction is rendered operative, either instead of gravitation, or else in aid thereof, for giving to magnetic needles which are employed for giving signals, a decided tendency to point in some particular direction, whenever they are not influenced by electric currents, and thereby caused to incline or deflect from that particular direction. But note, whereas similar applications of magnetic attraction have been made to magnetic needles used in the instruments called galvanometers, I make no claim to any such application, except to magnetic needles which are employed for giving signals.

Part F is the improvement hereinbefore described, in reference to figs. Æ, and e, and t, sheet B, respecting the sounding of alarums, whereby the angular motion communicated to a magnetic needle, which is disposed within the multiplying coils of conducting wire (in the manner described in the former specification, in reference to fig. s, sheet II, thereof), by transmission of an electric current through those coils, is now by this part, F, of my present improvement caused to disengage the stop detent of any sufficiently delicate watch or clock-work alarum, so as to allow the wheel-work thereof to be put in motion by the mechanical force of its own mechanism, in order to sound alarums by action of that mechanism. This mode of sounding alarums requiring no additional voltaic battery, as is the case in the mode described by the former specification, is particularly adapted for application to a portable apparatus, but it may be also applied to any apparatus, whether of the kind hereinbefore called terminal, or duplicate, or intermediate, as well as portable. And also, the magnetic needle, which, according to this part, F, of my present improvements, is to disengage the stop detent, and allow the clock or watch-work alarum to be sounded, may be one of those magnetic needles which is provided for exhibiting signals by its angular motion.—In witness whereof, &c.

Enrolled October 18, 1838.

Elevation of the back

Vertical section



For the connections with the bunnings 75, 76 see Figs. 8, Sheet II.
For the former Specification & Figs. L & P. Sheet A of the Present.